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10/678,766	10/02/2003	Eva Tois	SEPP21.001C1	1629

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EXAMINER	
SONG, MATTHEW J	

ART UNIT	PAPER NUMBER
1792	

NOTIFICATION DATE	DELIVERY MODE
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Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Notice of the Office communication was sent electronically on above-indicated "Notification Date" to the following e-mail address(es):

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Office Action Summary	Application No.	Applicant(s)	
	10/678,766	TOIS ET AL.	
	Examiner	Art Unit	
	MATTHEW J. SONG	1792	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE *3* MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *18 May 2009*.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1,3-24 and 26-41* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1,3-24 and 26-41* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO/SB/08) Paper No(s)/Mail Date _____.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .
5) ☐ Notice of Informal Patent Application
6) ☐ Other: _____.

DETAILED ACTION

Continued Examination Under 37 CFR 1.114

1. A request for continued examination under 37 CFR 1.114, including the fee set forth in 37 CFR 1.17(e), was filed in this application after final rejection. Since this application is eligible for continued examination under 37 CFR 1.114, and the fee set forth in 37 CFR 1.17(e) has been timely paid, the finality of the previous Office action has been withdrawn pursuant to 37 CFR 1.114. Applicant's submission filed on 4/20/2009 has been entered.

Claim Rejections - 35 USC § 103

2. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

This application currently names joint inventors. In considering patentability of the claims under 35 U.S.C. 103(a), the examiner presumes that the subject matter of the various claims was commonly owned at the time any inventions covered therein were made absent any evidence to the contrary. Applicant is advised of the obligation under 37 CFR 1.56 to point out the inventor and invention dates of each claim that was not commonly owned at the time a later invention was made in order for the examiner to consider the applicability of 35 U.S.C. 103(c) and potential 35 U.S.C. 102(e), (f) or (g) prior art under 35 U.S.C. 103(a).

3. Claims 1, 3-9, 11-24, and 26-41 are rejected under 35 U.S.C. 103(a) as being unpatentable over George et al ("Surface Chemistry for Atomic Layer Growth") in view of Sandhu et al (US 6,313,035), Leskela et al (Journal De Physique IV for IDS filed 10/31/2007), Suntola et al (US 6,015,590) and Juvaste et al ("Aminosilane as a coupling agent for cyclopentadienyl ligands on silica").

George et al discloses a method of atomic layer growth of SiO_2 using $SiCl_4$ and H_2O in an atomic layer epitaxial method. George et al also discloses deposition of other oxides such as Al_2O_3, SnO_2, TiO_2, ZrO_2, In_2O_3, and HfO_2 (pg 13122). George et al also discloses The surface functional groups also provide the technical means to alternate between various materials with atomic layer control and form superlattices (pg 13131), this clearly suggests applicants' multicomponent mixed oxide thin film because applicant's teach that a multicomponent film is achieved by growing some other oxide onto the growth substrate between silicon dioxide growth cycles, note paragraph [0041] of the published specification in US 2004/0065253. George et al discloses repeating A and B reactions to form a desired layer (pg 13124), this reads on applicant's plurality of deposition cycles.

George et al does not disclose a multicomponent thin film comprising silicon and a transitional metal. George et al discloses ALE for a variety of oxide materials including SiO_2 and Al_2O_3, SnO_2, TiO_2, ZrO_2, In_2O_3, and HfO_2.

In a method of forming a multicomponent oxide layer, note entire reference, Sandhu et al teaches a multi-component oxide layer comprises a mixture of a metal oxide and silicon oxide, specifically a silicon oxide and titanium oxide (claims 1 and 3). Sandhu et al also teaches the multi-component layer may be formed using CVD and may also be deposited using other

processes (Abstract). Sandhu et al teaches the titanium silicon oxide layer may be used in a memory cell, as a capacitor oxide or other semiconductor devices or structures (col 8, ln 1-35). Sandhu et also teaches other combinations of dielectric and metals can be used. (col 8, ln 1-35).

Therefore, it would have been obvious to a person of ordinary skill in the art at the time of the invention to modify George et al by selecting silicon dioxide and Al_2O_3, SnO_2, TiO_2, ZrO_2, In_2O_3, or HfO_2 because a mixture of a metal oxide and a silicon oxide to form a useful multi-component oxide layer which can be used to manufacture a useful semiconductor device, as taught by Sandhu et al (col 8, ln 1-65).

The combination of George et al and Sandhu et al does not teach a plurality of consecutive deposition cycles that each deposit only a $MSiO_x$.

Leskela et al teaches ternary metal oxides by ALE formed by pulsing the precursors in a sequence corresponding to the stoichiometry. (C5-946), this clearly suggest applicant's plurality of consecutive deposition cycles that each deposit only a $MSiO_x$ because only M, Si and O are used in the deposition, where M is A1, Si is A2 and O is B, based on the reactants taught by George et al.

It would have been obvious to a person of ordinary skill in the art at the time of the invention to modify the combination of George et al and Sandhu et al by using a 1:1 ratio to produce a ternary oxide having a desired stoichimetry, as taught by Leskela et al. The combination of George et al, Sandhu et al and Leskela et al does not teach purging the reactor with an inert gas after each pulsing.

In a method of growing thin films using atomic layer epitaxy, Suntola et al teaches an interval between reactant pulses for evacuation of the entire gas volume in an apparatus during

the interval between two successive reactant pulses and an inactive gas, this reads on applicant's inert gas, may be advantageously introduced to the reaction space during the evacuation (col 11, ln 20-40).

It would have been obvious to a person of ordinary skill in the art at the time of the invention to modify the combination of George et al, Sandhu et al and Leskela et al by purging the reactor with an inactive gas to prevent CVD film growth conditions, which are detrimental in an atomic layer epitaxy process (col 7, ln 50 to col 8, ln 20), as taught by Suntola et al.

As to the limitation "contacting the substrate in a flow type reactor", apparatus limitations, unless they affect the process in a manipulative sense, may have little weight in process claims. *In re Tarczy-Hornoch* 158 USPQ 141, 150 (CCPA 1968). In this case, the apparatus limitation does not affect the process in a manipulative sense, thus have been given little patentable weight. Furthermore, Juvaste et al teaches the deposition of aminosilane on a silica substrate with OH groups in a commercial F-120 flow type ALCVD reactor (Abstract and pg 38, 39 and 44). It is noted that applicant's also teach the use a F-120 reactor (See page 10 of the specification). Therefore, It would have been obvious to a person of ordinary skill in the art at the time of the invention to modify the combination of George et al, Sandhu et al, Leskela et al and Suntola et al by using a commercially available and well known ALCVD reactor which is known to be capable of deposition an aminosilane compound on a silica substrate, as evidenced by Juvaste et al.

Referring to claim 2, the combination of George et al, Sandhu et al, Leskela et al, Suntola et al and Juvaste et al teaches the growth rate is dependent on the number of reaction cycles (pg

13127), this clearly suggests applicant's process is repeated to form a layer of a desired thickness.

Referring to claim 3-7, the combination of George et al, Sandhu et al, Leskela et al, Suntola et al and Juvaste et al teaches using $SiCl_4$, $HfCl_4$ and H_2O as reactants (pg 13122).

Referring to claim 8-9, the combination of George et al, Sandhu et al, Leskela et al, Suntola et al and Juvaste et al teaches deposition at 600 K (~327°C) (pg 13123).

Referring to claim 11-12, the combination of George et al, Sandhu et al, Leskela et al, Suntola et al and Juvaste et al teaches groove material with flat portions (Figure 1).

Referring to claim 13, the combination of George et al, Sandhu et al, Leskela et al, Suntola et al and Juvaste et al teach the deposition of dielectric films on trench or stacked capacitors for DRAM high storage memory (pg 13130) and Sandhu et al teaches forming a variety of semiconductor devices (col 8, ln 20-30); therefore forming on an electrode to form a semiconductor device would have been obvious to one of ordinary skill in the art.

Referring to claim 14-15, the combination of George et al, Sandhu et al, Leskela et al, Suntola et al and Juvaste et al teaches a superlattice structure formed by alternating various materials, which include HfO_2, TiO_2, Al_2O_3 and ZrO_2 (pg 13122 and 13131).

Referring to claim 16-18, the combination of George et al, Sandhu et al, Leskela et al, Suntola et al and Juvaste et al teaches SiO_2 gate oxides in MOSFET devices (pg 13121 col 1), deposition on a silicon surface (pg 13123 col 1) and the deposition higher dielectric gate oxide materials, such as TiO_2 and Al_2O_3 (pg 13130 col 2).

Referring to claims 19-20 and 40-41, the combination of George et al, Sandhu et al, Leskela et al, Suntola et al and Juvaste et al teaches pulsing reactants to produce a desired

stoichimetery, this clearly suggests using different ratios and stoichiometric films (Leskela et al pg C5-946).

Referring to claim 22, the combination of George et al, Sandhu et al, Leskela et al, Suntola et al and Juvaste et al teaches forming silicon oxide by pulsing a silicon compound followed by H_2O, forming a metal compound by pulsing a metal compound followed by H_2O (George pg 13122) and purging the reactor between reactant pulses ('590 col 11, ln 30-40) to form a superlattice of various materials (pg 13131).

Referring to claim 24, the combination of George et al, Sandhu et al, Leskela et al, Suntola et al and Juvaste et al teach self-limiting reactions (George et al Abstract).

Referring to claim 34-35, a cycle is a relative term and thus can be defined to include multiple layer depositions, i.e. a cycle can be defined to be two silicon oxide layer and two metal oxide layers. The combination of George et al, Sandhu et al, Leskela et al, Suntola et al and Juvaste et al clearly suggest a cycle of Si→oxygen→metal→oxygen→Si→oxygen→metal→oxygen, which includes multiple silicon and first reactants a plurality of times in a cycle.

Referring to claim 36-39, the combination of George et al, Sandhu et al, Leskela et al, Suntola et al and Juvaste et al et al teaches a similar method of alternating silicon and metal oxide deposition. The combination of George et al, Sandhu et al, Leskela et al, Suntola et al and Juvaste et al does not teach the growth rate of the $MSiO_x$ is higher than the rate of ALD of the metal oxide and silicon oxide from which the metal oxide is formed. This limitation is directed to an effect of the process; therefore the effect of increased growth rate is expected because a similar method is expected to produce similar results.

4. Claim 10 is rejected under 35 U.S.C. 103(a) as being unpatentable over George et al ("Surface Chemistry for Atomic Layer Growth") in view of Sandhu et al (US 6,313,035), Leskela et al (Journal De Physique IV for IDS filed 10/31/2007), Suntola et al (US 6,015,590) and Juvaste et al ("Aminosilane as a coupling agent for cyclopentadienyl ligands on silica").as applied to claims 1, 3-9, 11-24, and 26-41 above, and further in view of Lowrey et al (US 5,891,744).

The combination of George et al, Sandhu et al, Leskela et al, Suntola et al and Juvaste et al teach all of the limitations of claim 10, as discussed previously, except the thin multicomponent oxide is formed on a hemispherical grain structure.

In a method of monitoring the effects of hemispherical grains, Lowrey et al teach the capacitance of a polysilicon layer can be increased by increasing surface roughness of the polysilicon film and one type of polysilicon film, which maximizes a roughness of an outer surface is hemispherical grain polysilicon (col 1, ln 10-67). Lowery et al also teaches deposition of a dielectric on a hemispherical grain area, which forms a capacitor (col 4, ln 1-15).

The combination of George et al, Sandhu et al, Leskela et al, Suntola et al and Juvaste et al teach the deposition of dielectric films on trench or stacked capacitors for DRAM high storage memory (George pg 13130 col 2). Therefore, it would have been obvious to a person of ordinary skill in the art at the time of the invention to modify the combination of George et al, Sandhu et al, Leskela et al, Suntola et al and Juvaste et al by deposition the dielectric layer on a substrate having a hemispherical grain, as taught by Lowery et al, to enhance the capacitance of the capacitor.

Response to Arguments

5. Applicant's arguments with respect to claims 1, 3-24, and 26-41 have been considered but are moot in view of the new ground(s) of rejection.

6. The declaration under 37 CFR 1.132 filed 4/20/2009 is insufficient to overcome the rejection of claims 1, 3-24, and 26-41 based upon 35 U.S.C. 103 as set forth in the last Office action because: first the declaration alleges that a person of ordinary skill in the art would recognize a flow type reactor as a reactor in which reactants are flow through the reactor. The declaration takes a narrow view of the claimed limitation which is not commensurate with the scope of the claims or the original disclosure. The declaration states process features of a flow type reactor which are not supported. It is also noted that the declaration attempts to state the flow type reactor affects the process in a manipulative sense, however the declaration would create 35 USC 112 first and second paragraph rejection problems because would be unclear how the flow type reactor would affect the process in a manipulative sense because the declaration states in paragraph 5 that "the flow type reactor is a reactor in which reactors and/or inert gases are subsequently and/or separately flowed through the reactor during an ALD deposition cycle and as a reactor being continuously pumped" because it is unclear what feature are actually claimed because of the "and/or" features.

Second, the declaration states George et al teaches backfill reactor, not a flow through reactor. Again the declaration is not commensurate in scope with the disclosed or claimed invention. The declaration also states that the one of ordinary skill in the art would not have

expected the George et al process to work in a flow type apparatus because of the long and undisturbed exposure. George et al does not limit the invention to a static fill reactor. It is also noted that an ALCVD flow type reactor is conventionally known in the art and has been used to deposit aminosilane on a silica substrate; therefore there evidence that one of ordinary skill in the art would have a reasonable expectation of success using a flow type reactor alleged by the declarant.

The declaration alleges no signification SiO_2 film growth occurs in flow type reactor and references the Tuominen Declaration filed 11/29/2007 however the declaration fails to compare the closest prior art of Klaus et al. The Tuominen declaration performs ALD using $SiCl_4$ at a deposition temperature of 300°C. However, George et al teaches deposition of $SiCl_4$ requires deposition temperature of 600°K (327°C) (pg 13123); therefore no growth at 300°C is expected. It is noted that the Tuominen declaration performs the claimed deposition at 350°C in comparison. The declaration also alleges unexpected results, however the declaration is not commensurate with the scope of the claims. The claims do not recite any particular reactants, size of precursors, density of the reactive surface sites, etc. The declaration states in paragraph 18 that all ALD processes will produce unique growth rates depending on the particular chemicals used, deposition temperatures, and many other factors. It is also noted that the declaration filed 11/29/2007 by Touminen alleges a growth rate of 0.24 Angstroms per cycle using TDMAS as precursor however George et al teaches 1.1 angstroms per cycle for $SiCl_4$. The declaration fails to compare the closet prior art to show unexpected results; therefore is not persuasive.

7. Applicant's arguments filed 4/20/2009 have been fully considered but they are not persuasive.

Applicant's argument that a flow type reactor must be given patentable weight and is not taught by the prior art is noted but not found persuasive. First, a flow type reactor is given little patentable weight but not as alleged by applicant. As discussed above the declaration is not commensurate in scope with the claimed invention or the original disclosure. Also, the declaration creates 35 U.S.C. 112 first and second paragraph rejection complications if the declaration allegations about the process features of a flow type reactor were read into the claim. The Examiner does not interpret the flow type reactor limitation in the manner in the declaration states in paragraph 4 that "the flow type reactor is a reactor in which reactors and/or inert gases are subsequently and/or separately flowed through the reactor during an ALD deposition cycle and as a reactor being continuously pumped" because this is not the broadest reasonable interpretation of the claim and the claims do not recite these process limitations. Finally, an ALCVD F-120 reactor used for the deposition of aminosilanes is conventionally known in the art; therefore the modification to use a commercially available ALCVD reactor would have been obvious to one of ordinary skill in the art.

In response to applicant's argument that the references fail to show certain features of applicant's invention, it is noted that the features upon which applicant relies (i.e., the flow type reactor is a reactor in which reactants and/or inert gases are subsequently and/or separately flowed through the reactor during an ALD deposition cycle and as a reactor being continuously pumped) are not recited in the rejected claim(s). Although the claims are interpreted in light of the specification, limitations from the specification are not read into the claims. See *In re Van*

Geuns, 988 F.2d 1181, 26 USPQ2d 1057 (Fed. Cir. 1993). It is noted that these limitation are not even present in the specification.

Applicant's argument regarding unexpected results is noted but not found persuasive. As discussed above, the declaration does not compare the closest prior art and the declaration operates at a temperature below the temperature taught by the prior required for deposition. Also, applicant's alleged evidence is not commensurate in scope with the claimed invention. The declaration clearly states growth rate is dependant on precursors, temperature, substrate surface groups etc. Therefore, the claims are not commensurate in scope because the claims do not claim any particular process parameters. There are no unexpected results in view of George et al teaches growths rates (1.1 angstrom per cycle) which is greater than or equal to applicant's alleged unexpected result.

In response to applicant's argument that there is no suggestion to combine the references, the examiner recognizes that obviousness can only be established by combining or modifying the teachings of the prior art to produce the claimed invention where there is some teaching, suggestion, or motivation to do so found either in the references themselves or in the knowledge generally available to one of ordinary skill in the art. See *In re Fine*, 837 F.2d 1071, 5 USPQ2d 1596 (Fed. Cir. 1988)and *In re Jones*, 958 F.2d 347, 21 USPQ2d 1941 (Fed. Cir. 1992). In this case, Sandhu et al also teaches the multi-component layer may be formed using CVD and may also be deposited using other processes (Abstract) and Sandhu et al teaches the titanium silicon oxide layer may be used in a memory cell, as a capacitor oxide or other semiconductor devices or structures (col 8, ln 1-35). The deposition of a $MSiO_x$ layer to produce useful devices is a clear motivation to combine.

Applicant's argument regarding the whether deposition is even possible is noted but not persuasive. Leskela et al teaches ternary metal oxides by ALE formed by pulsing the precursors in a sequence corresponding to the stoichiometry. (C5-946), which is clear evidence that multicomponent oxides may be formed by ALE. Furthermore, Niinisto et al ("Synthesis of oxide thin films and overlayers by atomic layer epitaxy for advanced applications") teaches Atomic layer epitaxy can be used for deposition of ternary and quaternary oxides, and the ALE deposition of ZrO_2, TiO_2, HfO_2, Ta_2O_5, Al_2O_3, Y_2O_3, and the required precursor combinations of halide compounds and water (Niinisto Abstract and Table 2).

Applicant's argument regarding Leskela et al teaches away from a stoichiometric metal silicon oxide is noted but not found persuasive. Leskela et al teaches correct stoichiometry is more difficult but does not teach that correct stoichiometry cannot be achieved. Applicant merely teaches stoichiometry is achieved by the number of Si and M cycles which is within the ordinary skill in the art in view of Leskela's teachings.

Conclusion

8. The prior art made of record and not relied upon is considered pertinent to applicant's disclosure.

Niinisto et al ("Synthesis of oxide thin films and overlayers by atomic layer epitaxy for advanced applications") teaches Atomic layer epitaxy can be used for deposition of ternary and quaternary oxides, and the ALE deposition of ZrO_2, TiO_2, HfO_2, Ta_2O_5, Al_2O_3, Y_2O_3, and the required precursor combinations of halide compounds and water (Niinisto Abstract and Table 2).

9. Any inquiry concerning this communication or earlier communications from the examiner should be directed to MATTHEW J. SONG whose telephone number is (571)272-1468. The examiner can normally be reached on M-F 9:00-5:00.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Michael Kornakov can be reached on 571-272-1303. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

Matthew J Song
Examiner
Art Unit 1792

MJS
June 22, 2009

/Robert M Kunemund/

Primary Examiner, Art Unit 1792